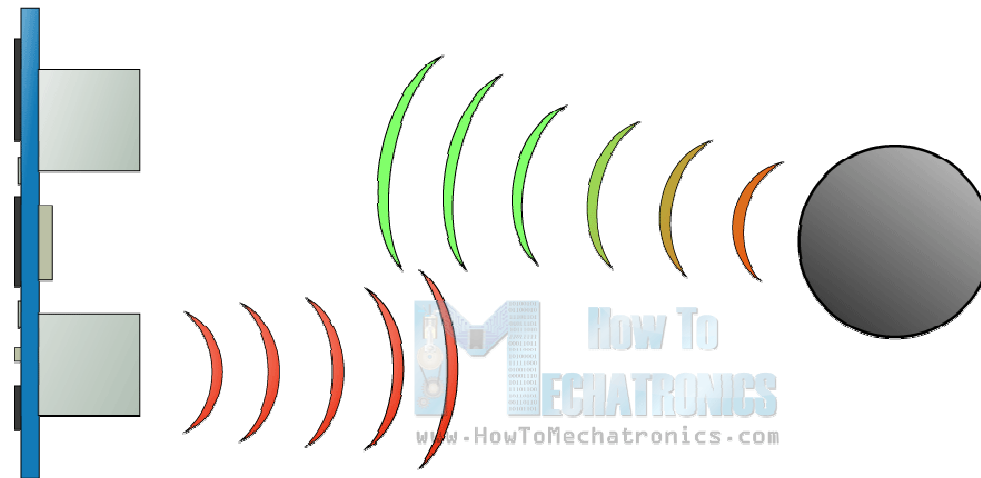# Robot Programming #12

Sensors

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Ultrasonic Sensor

- It emits an ultrasound at 40 000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.
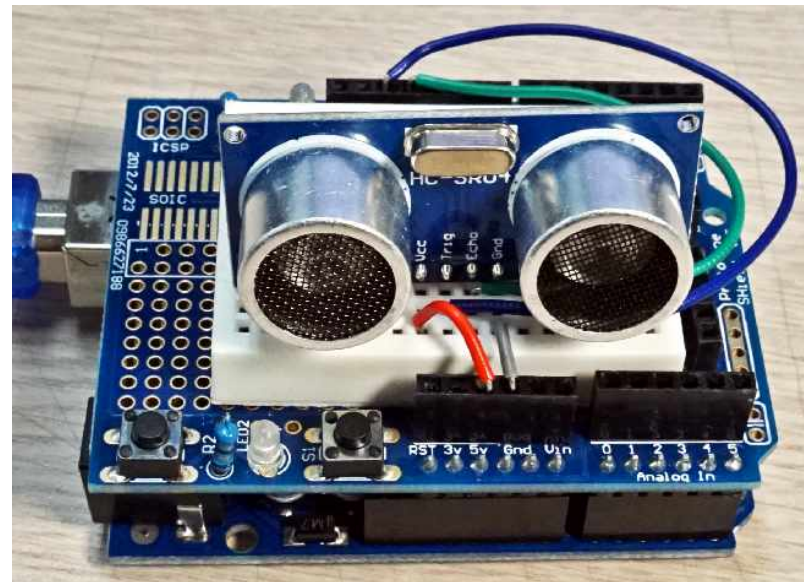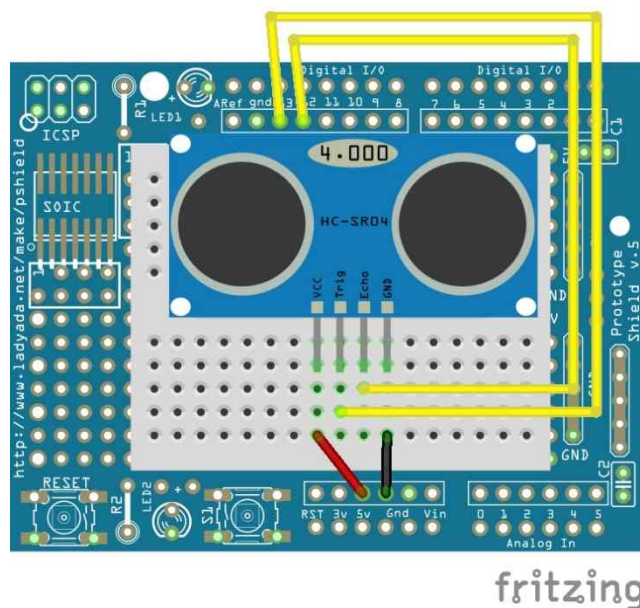
Ultrasonic Sensor

- The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo.

- In order to generate the ultrasound you need to set the Trig on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave traveled.

Ultrasonic Sensor

- Connect the ultrasonic sensor to Arduino as shown.

Ultrasonic Sensor

```cpp
int trigPin = 13;
int echoPin = 12;

void setup(){
  Serial.begin(9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
}

void loop(){
  float duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = ((float)(340 * duration) / 1000) / 2;

  Serial.print("Duration:");
  Serial.print(duration);
  Serial.print("\nDIstance:");
  Serial.print(distance);
  Serial.println("mm\n");
  delay(500);
}
```
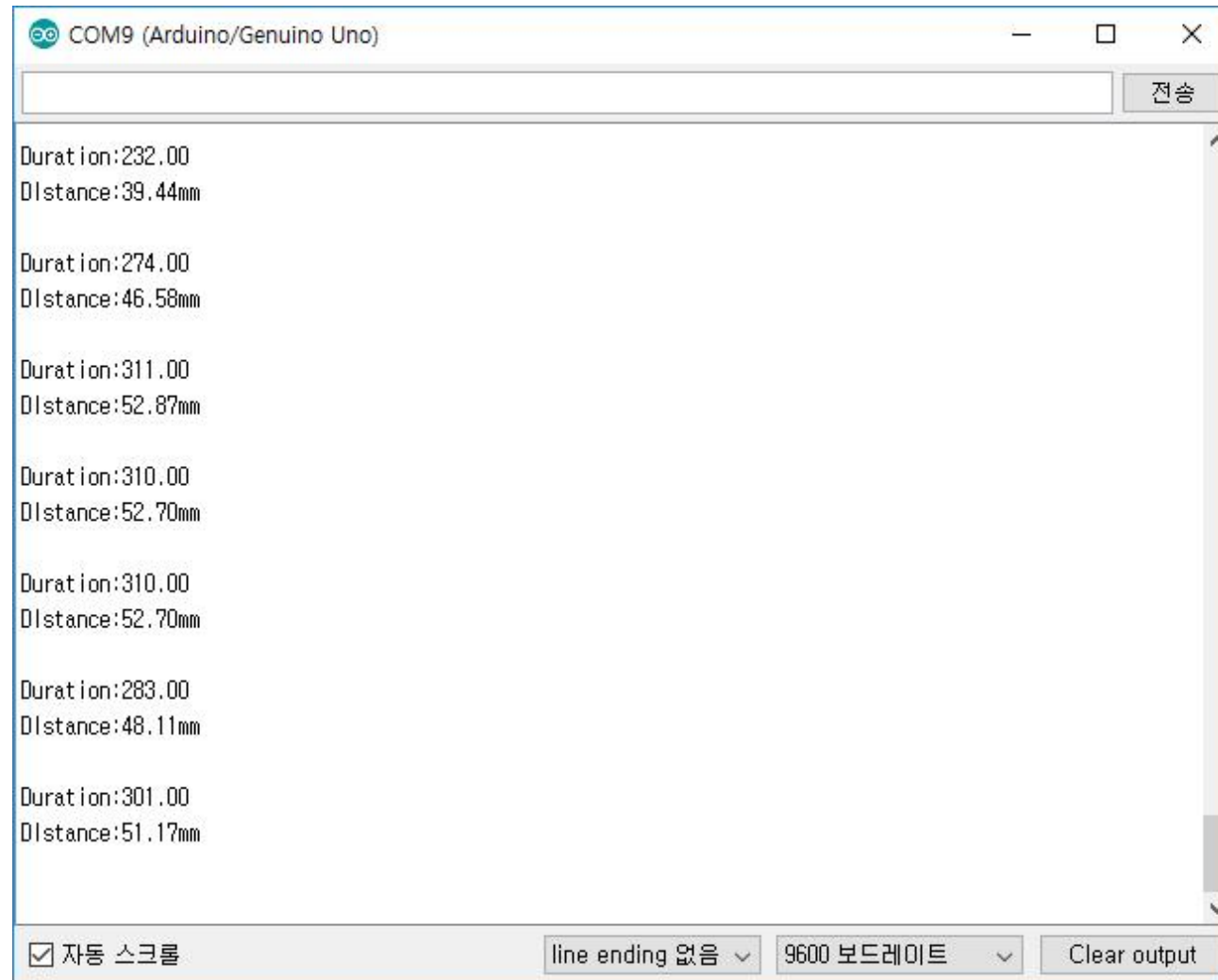
Ultrasonic Sensor

A Closer Look

- Trig pin is put to HIGH for 10 millisecond.

```
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
```

- Measure travel time and calculation distance.

```
duration = pulseIn(echoPin, HIGH);
distance = ((float)(340 * duration) / 1000) / 2;
```
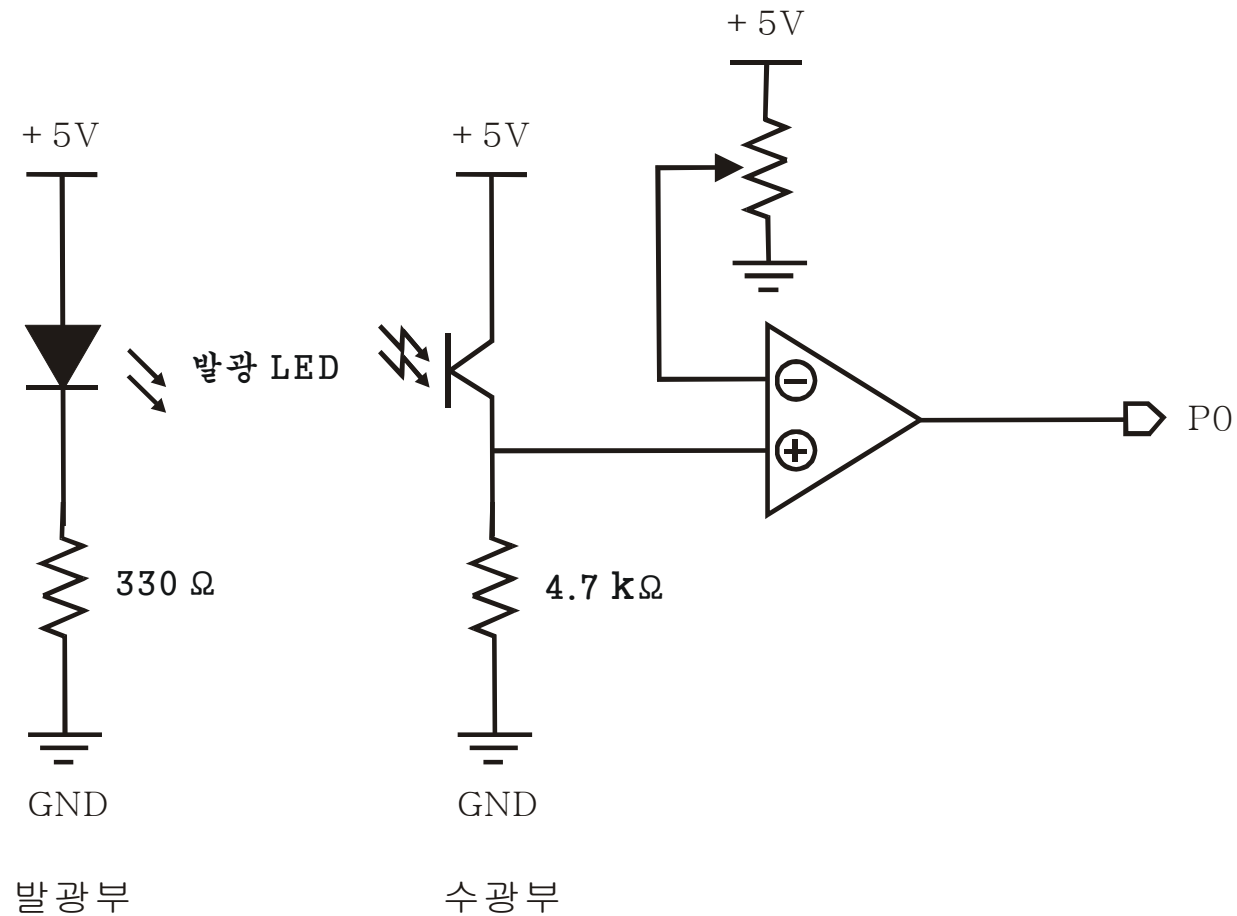
IR Sensor

- IR(InfraRed) sensor is a sensing device that picks up radiation in the infrared band.

- IR emitter is a device that radiates infrared light.

- It has been used extensively for TV remote controller and night vision cameras.
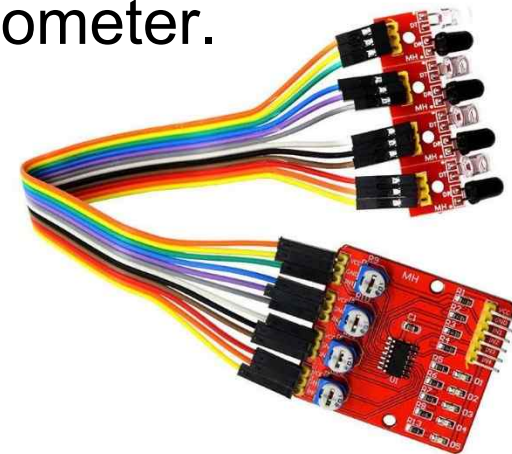
IR Transmitter and Receiver

- Let's consider the following circuit.

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IR Sensor Module

- We will use a IR sensor module.

- This module incorporates the previous detecting circuit.

- IR sensor module is suitable for line tracer.

- 4ch IR sensor board has emitter and detector.

- Sensor output is 0 or 5V.

- Sensitivity is controlled by a potentiometer.

- It needs 5V power supply.

4 Channel IR Sensor Module

- **Microcontroller Interface**
    1. VCC: 3.3V-5V power input pin
    2. GND: 0V pin
    3. IN1: Digital Output of Sensor 1
    4. IN2: Digital Output of Sensor 2
    5. IN3: Digital Output of Sensor 3
    6. IN4: Digital Output of Sensor 4

- **Sensor Interface**
    1. VCC: 3.3V-5V power input pin
    2. GND: 0V pin
    3. IN1: Output of Sensor 1
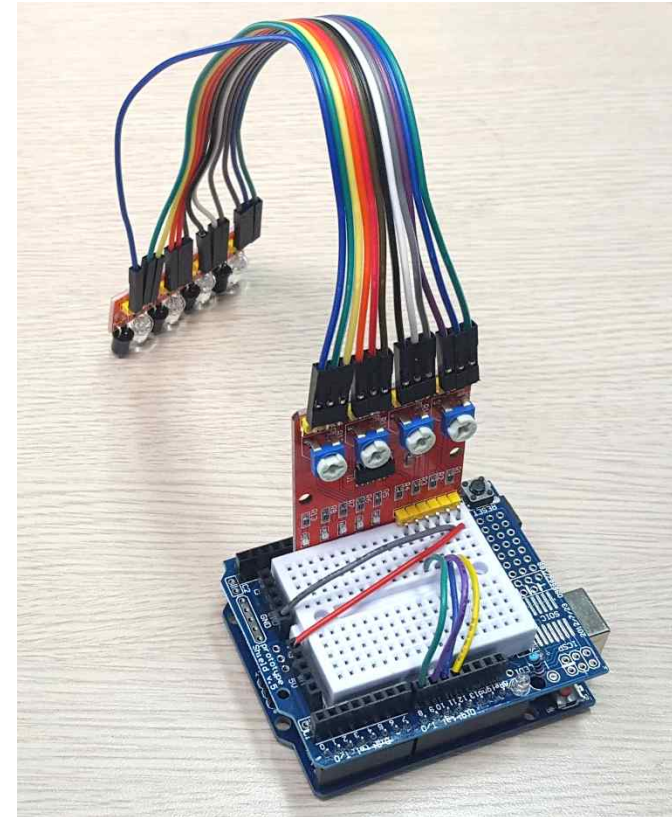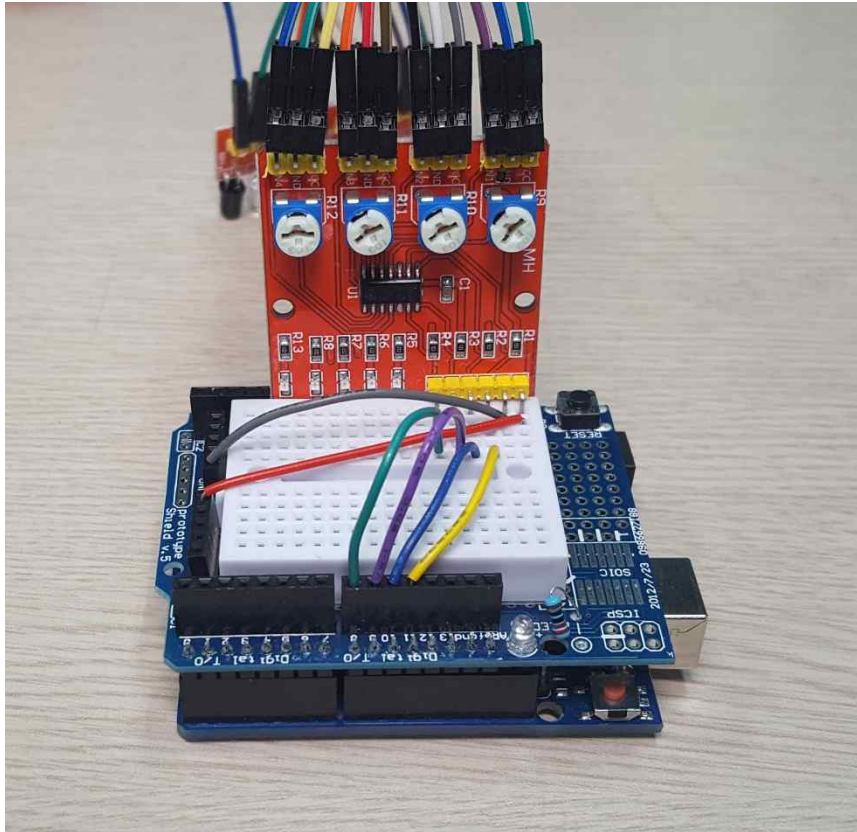
4 Channel IR Sensor Module

- Connect the IR Sensor to Arduino shield
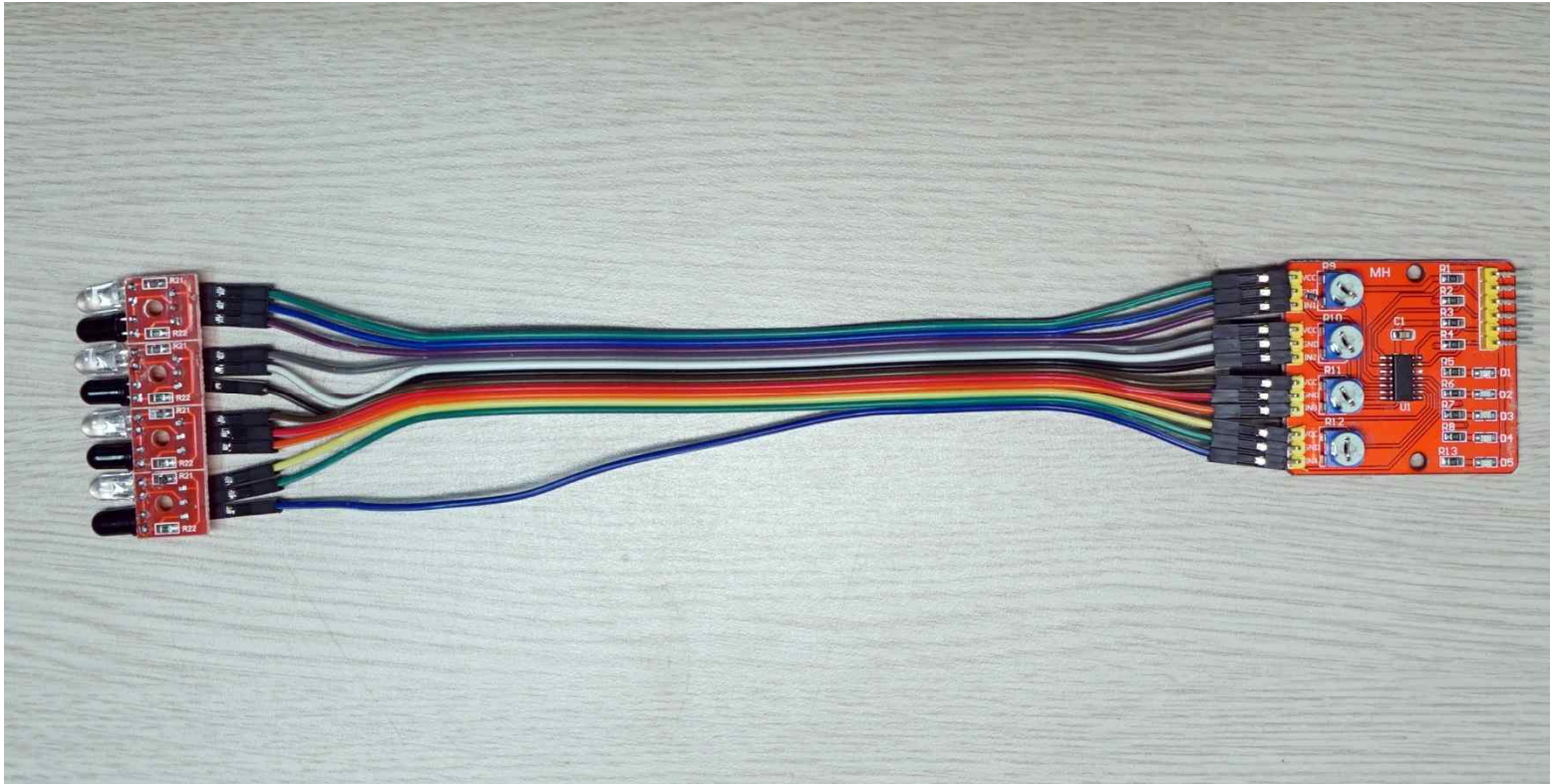
4 Channel IR Sensor Module

- Connect the IR Sensor to Arduino shield

IR Module Test

- Write the code to test the IR module.

```
int IR1 = 11;
int IR2 = 10;
int IR3 = 9;
int IR4 = 8;

int IR1_v = 0;
int IR2_v = 0;
int IR3_v = 0;
int IR4_v = 0;

void setup() {
  Serial.begin(9600);
}

void loop() {
  IR1_v = digitalRead(IR1);
  IR2_v = digitalRead(IR2);
  IR3_v = digitalRead(IR3);
  IR4_v = digitalRead(IR4);

  Serial.print(" ");
  Serial.print(IR1_v);
  Serial.print(" ");
  Serial.print(IR2_v);
  Serial.print(" ");
  Serial.print(IR3_v);
  Serial.print(" ");
  Serial.println(IR4_v);
  delay(300);
}
```

IR Module Test

- Serial monitor: